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CONSTRAINTS ON THE COMPOSITION OF JUPITER'S STRATOSPHERIC AEROSOLS FROM ULTRAVIOLET PHOTOMETRY

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The presentation by Tomasko *et al.* is largely contained in a paper which appears in the special issue of *Icarus* (1986; 65, 218-243). The abstract of the conference presentation is reproduced here:

Observations of the limb darkening of Jupiter obtained with the IUE satellite in the spectral range from 0.22 to 0.25 μm near the equator and at a latitude of 40 deg N have been reported by Tomasko and Martinek (1978, Bull. Amer. Astron. Soc. *10, 562), and an analysis of the data has been presented by Karkoschka and Tomasko (1984,* Bull. Amer. Astron. Soc. *16, 647). Here we extend the wavelength range over which the imaginary refractive index is derived by including IUE observations at 0.33 μm. This extension of the wavelength coverage appreciably strengthens the available constraints on the composition of the aerosol material. The brightness and limb darkening observations near 40 deg N determine the vertical location (near a pressure level of 25 mb), particle size (~0.2 μm radius), and column number density (5 to 10 x* 10^{-8} cm^{-2}*), as reported by Karkoschka and Tomasko. At this latitude, the stratospheric aerosols provide so much absorption that their imaginary index of refraction can be derived independent of the absorption produced by the underlying cloud material. The form of the variation of the imaginary index of the stratospheric aerosols determined from the high-latitude data has been compared to published measurements of the imaginary refractive index of several candidate materials produced by irradiating methane-hydrogen or methane-hydrogen-nitrogen mixtures with ultraviolet light (Podolak et al., 1979,* Icarus *40, 193-204) or energetic protons (Scattergood and Owen, 1977,* Icarus *30, 780-788) as well as recent measurements of Titan tholins (Khare et al., 1984,* Icarus *60, 127-137). The material produced by irradiating methane-hydrogen mixtures with energetic particles is not sufficiently absorbing longward of 0.25 μm. Tholins which include a large fraction of nitrogen in the original gas mixture are too absorbing. The best agreement is found for the measurements of acetylene irradiated by ultraviolet light. Near the equator, the stratospheric aerosols provide five to ten times less absorption than at high latitudes, and there is a relation between the absorption produced by the aerosols and the single scattering albedo of the underlying clouds. If the aerosol material is assumed to be the same as that found at higher latitudes, the wavelength dependence of the albedo of the "ammonia" clouds is obtained between 0.22 and 0.33 μm.*

DR. ROSSOW: One obvious candidate particle is ammonia. Did you look at the ammonia absorption at these wavelengths?

DR. TOMASKO: As far as I am aware, ammonia absorbs very little at these wavelengths, not nearly enough to be consistent with these kinds of numbers. That's why I was puzzled by the results presented in a paper earlier in this session. I don't think pure ammonia is going to provide these kinds of numbers. Gaseous ammonia only starts to absorb shortward of 2200 Å, and I think the solid phase will be somewhat similar.

DR. ROSSOW: So at longer wavelengths...

DR. TOMASKO: Yes, that's why we like this region between 2500 and 2200 Å. If you remember Bob West's slide, the albedo of Jupiter drops from the visible down to 3000 Å, and rises shortward of 3000 Å due to Rayleigh scattering. At 2500-2200 Å it gets flat, and that is a region where there is no gaseous absorber known as far as I am aware that could do that. We think it's due to the aerosols. Shortward of 2200 Å, ammonia and other gaseous constituents may come in.

DR. ROSSOW: Did you try models with much larger single scattering albedos for the deep cloud?

DR. TOMASKO: At high latitudes, it doesn't make much difference from the curve I showed, which varied between 0.6 and 0.95. At low latitudes, anything goes; there is a whole range of possibilities. If you like to think that the low latitude stratospheric aerosols are different from the high latitude statospheric aerosols, you could make them darker and then require less absorption in the ammonia cloud beneath. That could probably work too.

DR. ROSSOW: So you didn't try retrieving your haze particle properties with an assumed ammonia cloud under it with a high single scattering albedo?

DR. TOMASKO: No, we didn't because we don't understand how that could be consistent in the blue wavelengths where the belts have single scattering albedos of 0.98, and the zones have single scattering albedos of 0.995 or something like that. There's a big difference in the single scattering albedo between belts and zones in the blue, and it can't all be just the ammonia. There has to be some absorber in the ammonia-type cloud particles, I think.

DR. ROSSOW: That wasn't the sense of my question. The sense of my question was what happens to your numbers if you were to put in a higher single scattering albedo for your low latitude...

DR. TOMASKO: Then you would extract even darker aerosol particles; that is, even higher imaginary refractive indices than the ones I've shown, or greater numbers of them, or some combination of the two. That's a big parameter space. There would be many permitted combinations.